III. Alarms and Troubleshooting Guide

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III. Alarms and Troubleshooting Guide

INTRODUCTION

This chapter describes possible causes for alarm messages and difficulties that may be encountered with suggestions for corrective measures. When the FMS2000 recognizes a situation that is compromising effective infusing, the system not only displays alarm message, instructions for corrective measure, and sounds an audible alarm, but it also stops pumping, heating, and revert valve into recirculate position. To silence the alarm and return to normal operation, follow instructions on the screen.

Operational alarms that may occur in the course of a procedure are:

- Air Detection
- Door Open
- Fluid Out
- High Pressure
- Low Battery
- Missing Disposable

Heating Alarms:

- Heating Fault
- Over Temperature

Hardware Alarms:

- Air Detector Fault
- Heater Fault Latch
- Heater Power Read Back Fault
- Heater Over Power Fault
- Power Module Overtemp
- Pump Fault
- Valve Fault
- Watch Dog

Other Operational Difficulties:

- Alarm volume too low
- Battery, no heating
- Dim display
- Flow rate is too slow or will not go to the set rate
- Key pad does not accept input, too sensitive, or not responsive
- No message, no power, power off immediately after turn on
- Pump running too loud
- System does not heat, does not prime
- Unable to calibrate temperature probe, unable to turn off

OPERATIONAL ALARMS

Operational alarms that may occur in the course of a procedure are:

Air Detection
Door Open
Fluid Out
High Pressure
Low Battery
Missing Disposable

1. AIR DETECTION

An air bubble in the Air Detection sensor located above the diversion valve will cause the pump and heating to stop. The Air Detection alarm (figure 1) and message will appear. The valve goes to the recirculate position.

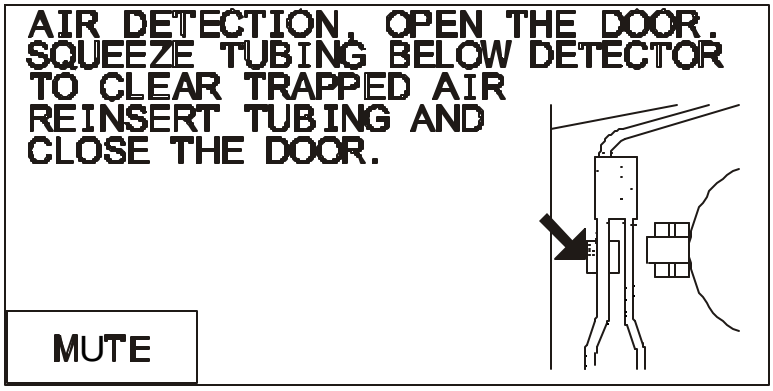

Figure 1. Air Detection alarm.

- Press MUTE to silence the alarm. Check for air in the line. Clear the air by removing the tubing from the air detector. Squeeze or tap the section of the tubing right below the air detector to clear any air bubbles trapped in the air detector back into the pressure chamber.

- Firmly reseat the tubing back into the air detector. Close the door. The screen in figure 2 will appear.

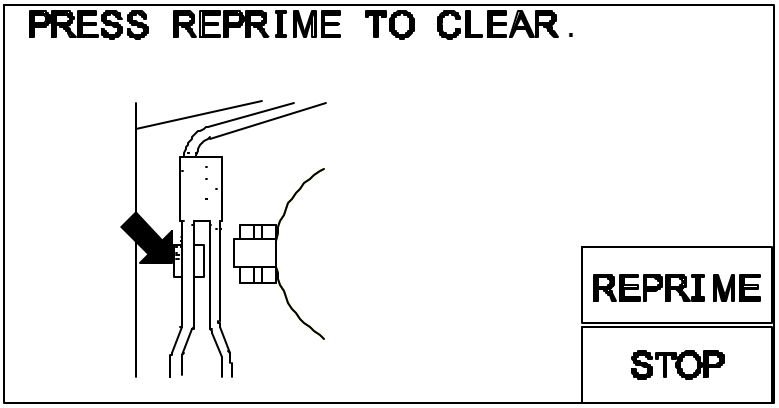

Figure 2. Air Detection alarm after checking the tubing in the air detector.

- Press REPRIME to recirculate the fluid and remove air in the main system. If the system does not complete the Reprime procedure because the hydrophobic filter on top of the reservoir chamber is clogged by blood particulates, see the previous section on how to complete the Reprime. The system will resume infusion upon completion of the Reprime.

2. DOOR OPEN

The system will not operate while the system door is open. If the door is opened while the system is pumping, the system will immediately stop heating and pumping. The valve will go to the recirculate position and an audible alarm will sound.

- Press the MUTE key to silence the alarm.
- Close the door without kinking the tubing. The error message will clear when the door is closed.

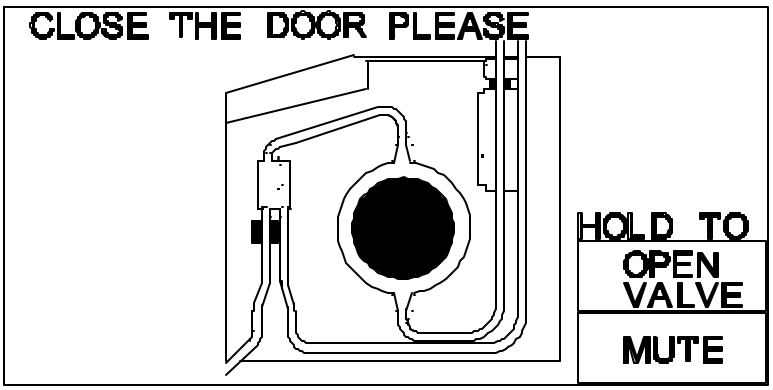

Figure 3. Door Open alarm

- If the disposable needs to be removed from the system, press and hold the OPEN VALVE to release the tubing. The valve will remain open and an audible alarm will sound while the key is pressed. Make certain the patient line is clamped shut to prevent uncontrolled fluid flow.

CAUTION:

While the open valve key is pressed, keep the patient line clamped closed to prevent uncontrolled fluid flow.

CAUTION:

Keep objects out of the valve path when releasing the open valve key to avoid injury.

3. FLUID OUT

If the blood or replacement fluid runs out while infusing or if the tubing in the fluid out detector is pulled or kinked, the pump and heating will stop. The Fluid Out message will display and an audible alarm will sound (figure 4). The valve will go to the recirculate position.

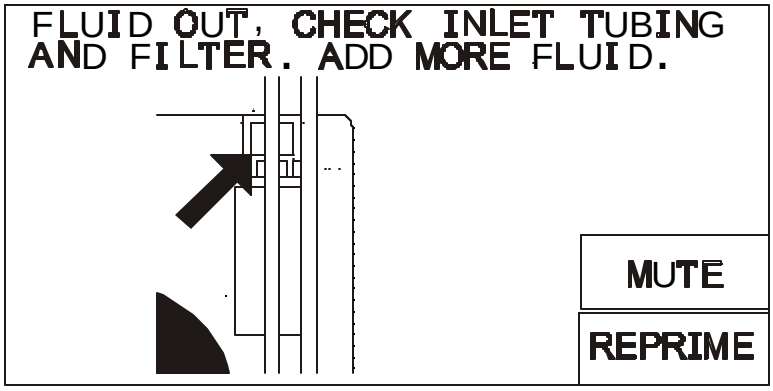

Figure 4. Fluid Out Alarm

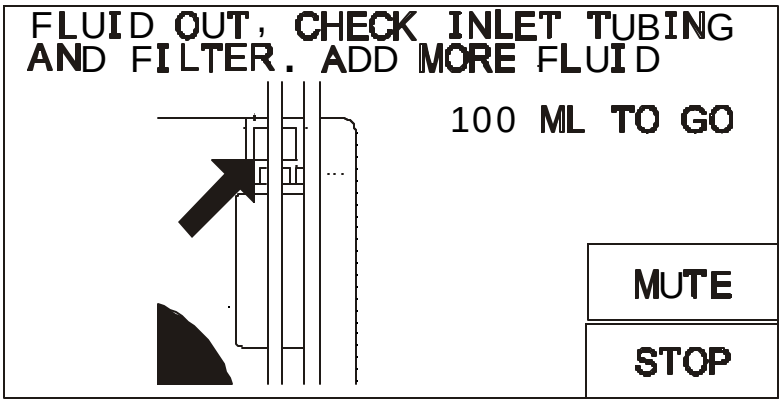

Figure 5. Fluid Out alarm after pressing REPRIME

- Press MUTE to silence the alarm..
- Clamp off the empty bags and bag spikes and replace with new fluid bags. Pierce new bags and unclamp bag spikes. Press REPRIME.
- The system will automatically stop and return to the Infuse screen after Reprime. Detection of air during the process will restart the 100 ml cycle.

- If the Reprime volume count does not count down from 100 to 0 ml, check that:

  - The bags are fully spiked and clamps are fully opened.
  - The pump tubing is not stretched and is seated firmly within the Fluid Out sensor.
  - Fluid Out sensor is clean and there is nothing obstructing contact with the sensor.

REPRIMING THE MAIN SYSTEM FLUID CIRCUIT WHEN THE RESERVOIR REMAINS EMPTY AFTER EXTENSIVE OPERATION

- If the Reprime procedure can not be completed or the reservoir chamber stays empty after a Reprime, the hydrophobic air vent filter on top of the reservoir chamber may be clogged by blood particulates. Under this condition, air in the reservoir chamber can be returned back into the fluid bag. This will allow the REPRIME procedure to force fluid to fill the chamber.

  - Pierce both bag spikes into separate fluid bags and open both clamps to allow the air in the reservoir chamber to escape into one of the fluid bags.

  - Press REPRIME to recirculate the fluid in the disposable set to remove air remaining in main system fluid circuit.

- Inspect the main system fluid circuit and patient line to make certain that there is no air.

- If the air could not be returned into the fluid bag, either replace reservoir chamber or restart the system and replace the disposable set and proceed with the original prime.

REPRIMING THE MAIN SYSTEM FLUID CIRCUIT WHEN PERSISTENT FLUID OUT ALARM OCCURS AFTER EXTENSIVE OPERATION

- Frequent or persistent Fluid Out alarm will occur when the coarse blood filter in the reservoir chamber becomes clogged by high amounts of particulates in the blood. Either replace the reservoir chamber or restart the system and replace the disposable set and proceed with the original prime.

- Use high quality infusate to avoid this problem.

CAUTION:

Use high quality infusate. High amounts of particulates in the blood may clog the bag filter and/or coarse blood filter inside the reservoir chamber. Replace bag filter, reservoir chamber and/or disposable set if filter(s) becomes clogged.

REPLACING THE RESERVOIR CHAMBER

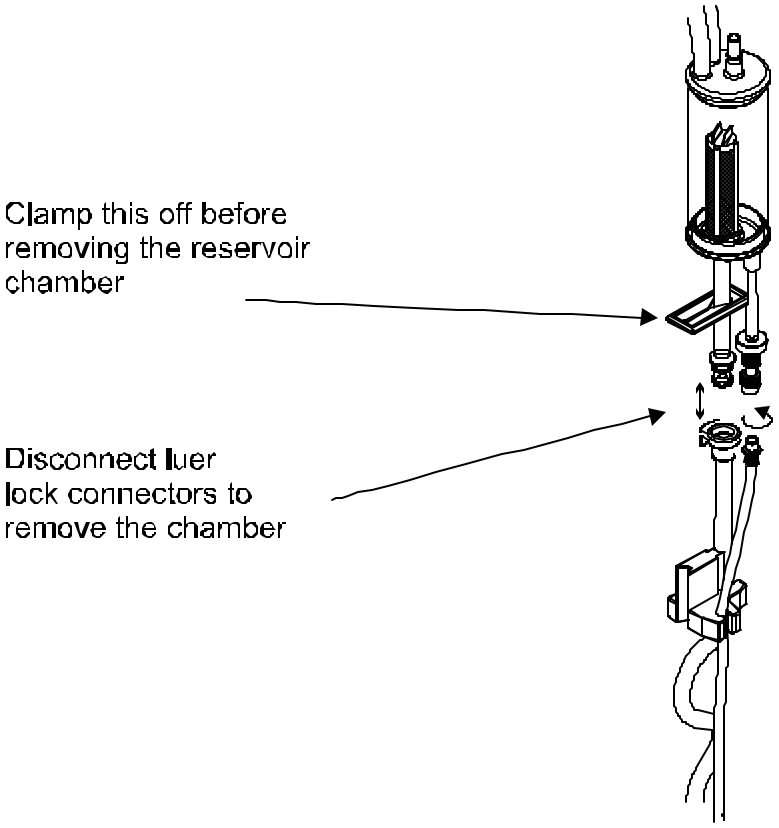

Figure 6. Replacing the Reservoir Chamber

- Clamp off the pump tubing with the large blue clamp.
- Open the luer connectors and disconnect the reservoir chamber. Using aseptic techniques, reconnect lines with a new chamber to continue.
- Take care not to kink or twist the lines. If fluid is spilled onto the Fluid Out detector, clean and dry the detector and tubing before continuing.

CAUTION:

For proper operation, keep the fluid out detector and pump tubing clean and dry.

4. HIGH PRESSURE

If the pressure in the line suddenly increases, pumping and heating will halt. An alarm will sound and the High Pressure message will appear (figure 7). The valve will go to the recirculate position.

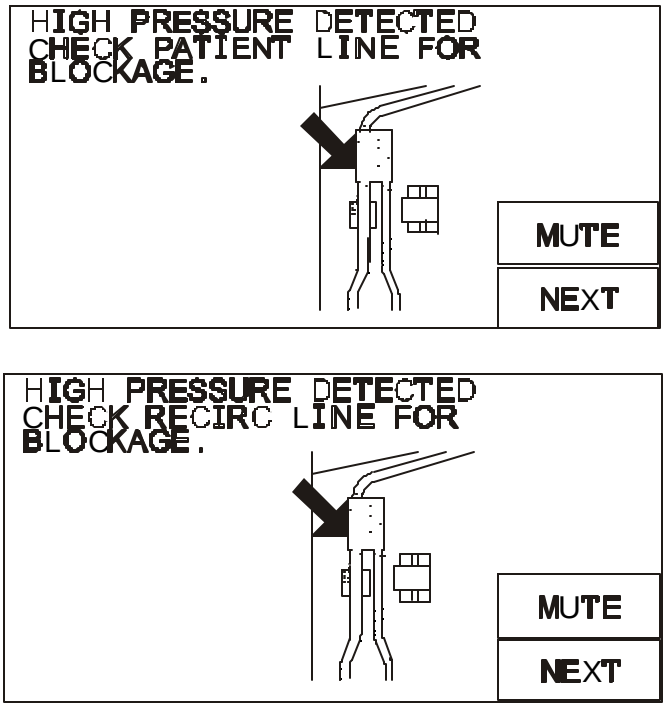

Figure 7. High Pressure alarm.

- Press MUTE to silence the alarm.
- If the patient line is indicated as the source of the alarm, check for obstructions or kinks in the patient line. Make certain that the infusion site is well placed and not blocked.
- If the recirculate line is indicated, check that the recirculation line is not obstructed.
- Use the appropriate infusion set recommended in the guide, Match the Infusion Set to Flow Rate and Fluid Type in Chapter II.
- Check pressure limit setting (in SERVICE MODE) to make certain that it is set appropriately. Use higher pressure limit, when possible, to a maximum value of 300 mmHg. A higher pressure limit will allow for higher flow rates and fewer incidences of HIGH PRESSURE alarm.
- Press NEXT to return to the infuse screen and continue to infuse at the previous rate.

5. Low Battery

- When the battery runs low, the system flashes BATT LOW message and sounds an audible alarm. The system should be plugged into an AC outlet to continue operation and charge the battery.

- The normal recharge time is 8 hours.

6. MISSING DISPOSABLE

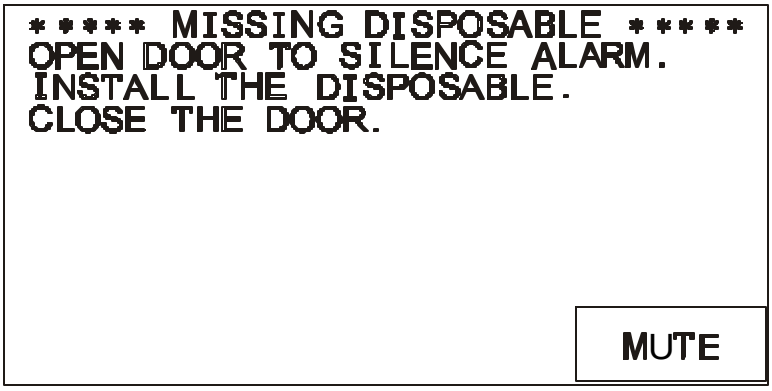

Figure 8. Missing Disposable set alarm

In AC operation, the system will check for the presence of a disposable set before the Prime screen at startup and every time the door is opened and closed. Install the disposable set and close the door to remove the alarm.

TROUBLESHOOTING ALARM MESSAGES

The following table describes alarms, messages, system responses, the possible condition that triggers the alarm, and troubleshooting actions the operator can take to rectify the situation.

A. OPERATIONAL ALARMS

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
AIR DETECTION **"AIR DETECTION, OPEN THE DOOR. SQUEEZE TUBING BELOW DETECTOR TO CLEAR TRAPPED AIR. REINSERT TUBING AND CLOSE THE DOOR."**	Air in the line. Tubing in the air detection sensor is not seated firmly in the detector. Leak in the disposable. Air detector sensor dirty. detector electronics defective.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Open the door to silence the alarm. Check for air bubbles and possible leaks. Squeeze the tubing directly below air detector to clear any trapped air out of the sensor. There should be no trapped air remaining within the air detector. Check the air detector and make certain that it is clean and nothing is obstructing the sensor. Reseat the tubing in the air detector and make certain that it is seated firmly in the sensor. Press REPRIME to reprime main system fluid circuit. Check for air in the disposable set and patient line before infusing.
DOOR OPEN **"CLOSE THE DOOR PLEASE"**	The door is open. No magnet in the door latch.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Close the door to silence the alarm and resume. Check magnet in the door latch.

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
FLUID OUT **"FLUID OUT, CHECK INLET TUBING AND FILTER. ADD MORE FLUID."**	Out of infusate. Bag clamps not fully opened. Bag not fully spiked. Tubing in the Fluid out sensor is not seated firmly in the detector. Tubing in the Fluid out sensor is stretched or tubing pulls away from the sensor, due to vacuum in the line. Clogged air vent filter. Clogged coarse blood filter. Reservoir or recirculate line is obstructed. Detector electronics defective.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Press MUTE to silence the alarm. If out of fluid, add additional fluid and press REPRIME. If the Reprime volume count does not count down from 100 to 0 ml: then • Check the bags are fully spiked and clamps are fully opened. • The reservoir chamber should be seated in the holder. Check that the pump head tubing is not stretched and is seated firmly within the fluid out sensor. • Check the fluid out sensor and make certain it is clean and there is nothing obstructing contact with the sensor. If the reservoir chamber stays empty during reprime, the air vent filter may be clogged. In this case, pierce the fluid bag(s) with bag spikes and fully open clamps to allow the air in the reservoir chamber to escape into fluid bag(s) and allow fluid to fill the reservoir chamber. High amounts of particulates in the blood will clog the coarse blood filter in the reservoir chamber. Replace reservoir chamber or disposable every 4 hours of operation.

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
HIGH PRESSURE **"HIGH PRESSURE DETECTED CHECK PATIENT LINE FOR BLOCKAGE."**	Patient line is blocked. Recirculate line is blocked. Infusion site is not well placed. The catheter bore size is too small. Pressure limit setting is set too low.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Make certain that the flow path is not blocked. Check that the recirculate line is not obstructed. Check that the infusion site is well placed and use the appropriate infusion set recommended in the guide, Match the Infusion Set to Flow Rate and Fluid Type in Chapter II. Increase pressure limit setting. Press NEXT to silence the alarm and resume. Check functionality of the pressure transducer by gently pressing the transducer. Pressure reading on screen should change. If not, it is defective, service machine.
LOW BATTERY	Battery voltage is too low	Flash LOW BATTERY message and sound periodic beep.	Plug the system into an AC outlet to continue operation and recharge the battery. Allow at least 8 hours to fully charge the battery. If LOW BATTERY displayed while plugging into the AC outlet, one of the components may be defective. Service machine.
MISSING DISPOSABLE **"***MISSING DISPOSABLE*** OPEN DOOR TO SILENCE ALARM. INSTALL THE DISPOSABLE. CLOSE THE DOOR."**	No disposable set in the unit.	Sound alarm and display message. Valve in the load position.	Properly install disposable. Press NEXT to resume.

B. HEATING ALARMS:

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
HEATING FAULT **"CHECK TEMPERATURE PROBE WINDOWS FOR BLOCKAGE. CLEAN WINDOWS IF NECESSARY. PRESS RETRY TO CLEAR. TURN OFF POWER AND SERVICE MACHINE IF ERROR PERSISTS"**	Wet, dirty or blocked disposable set windows. Wet, dirty or blocked IR probe. IR probe failure. Heater fault	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Check disposable set and flow path for occlusions. Make certain the windows on the disposable set and the IR probes are clean and dry and free from contaminates. Clean surfaces with moistened soft cloth if necessary. Dry off surfaces before continuing. Press RETRY to continue. Power down system and service machine if error persists.
OVER TEMPERATURE **"OVER TEMPERATURE. TURN OFF POWER. DISCARD BLOOD AND DISPOSABLE. RESTART SYSTEM WITH A NEW DISPOSABLE. SERVICE MACHINE IF PROBLEM PERSISTS."**	Fluid supply is over the temperature limit Temperature probes are wet, dirty, or blocked. Restricted flow or out of fluid.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Check disposable set and flow path for occlusions. Make certain the windows on the disposable set and the IR probes are clean and dry and free from contaminates. Clean surfaces with moistened soft cloth if necessary. Dry off surfaces before continuing. Make sure bag clamps are open and flow is unimpeded. Make sure that the filter is not clogged. Add more fluid, if fluid out. Clamp off the bag spikes and patient line and remove disposable. Power down and restart system with a new disposable. Service machine if the problem persists. **WARNING!** Do not infuse blood that is in the disposable set when over temperature condition occurs. Red cells that has been subjected to high temperature may not be safe to infuse.

C. HARDWARE ALARMS:

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
AIR DETECTOR FAULT **"AIR DETECTOR FAULT. TURN OFF POWER, SERVICE MACHINE."**	Air detector failure	Sound alarm and display Air Detector Fault error message and halt all operations.	Power down and service machine.
HEATER FAULT LATCH **"HEATER FAULT LATCH AT LOCATION A B C D. PRESS RETRY TO CONTINUE. SERVICE MACHINE IF ERROR PERSISTS."**	Excessive AC power line noise or internal failure	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Press RETRY to try again. Power down and service machine if error persists.
HEATER POWER READ BACK FAULT **"HEATER POWER I/O FAULT. RESTART SYSTEM AND RETRY. SERVICE MACHINE IF ERROR PERSISTS."**	Heater power feedback sense coil open. Power feedback circuit malfunction.	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position.	Restart the system, and try again. Power down and service machine if error persists.

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
HEATER OVER POWER FAULT **"HEATER OVER POWER FAULT. PRESS RETRY TO CONTINUE. SERVICE MACHINE IF ERROR PERSISTS."**	Heater hardware fault	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position. System will try to reset the error.	Push RETRY to try again. Power down and service machine if error persists.
POWER MODULE OVERTEMP **"POWER MODULE OVERTEMP FAULT. KEEP THE AIR INTAKE AT THE BOTTOM OF THE MACHINE CLEAR. PLEASE WAIT FOR SYSTEM TO CORRECT THE PROBLEM. SLOW DOWN THE FLOW RATE OR USE WARMER FLUID IF THE PROBLEM PERSISTS."**	Power driver module overheating	Stop pumping and heating. Sound alarm and display message. Valve in the recirculate position. Power goes low and the fan will go to maximum speed to cool the system.	Make certain that the fan air vents at the bottom of the machine are not blocked. Wait for unit to correct problem. Display will return to Infuse screen when the error clears. Press MUTE to silence the alarm. Power down and service machine if error persists.
PUMP FAULT **"PUMP FAULT, CHECK PUMP FOR BLOCKAGE. RESTART SYSTEM OR PRESS RETRY. SERVICE MACHINE IF ERROR PERSISTS."**	Pump tubing is installed incorrectly Pump failure Pump speed feedback encoder failure. Pump runs out of control or not at all.	Stop pumping and heating. Sound alarm and display message. Valve to the recirculate position.	Check that pump tubing is seated on the pump head correctly. Check that pump turns freely and head is clean. Press Retry to try again. Power down and service machine if error persists.

ALARM MESSAGE	POSSIBLE CONDITION	SYSTEM RESPONSE	OPERATOR ACTION
VALVE FAULT **"VALVE FAULT, CHECK VALVE FOR BLOCKAGE. RESTART SYSTEM AND RETRY. SERVICE MACHINE IF ERROR PERSISTS."**	Valve failure Valve position sensor malfunction	Stop pumping and heating. Sound alarm and display message.	Check that the valve is not blocked. Restart the system and try again. Power down and service machine if error persists. **CAUTION:** In a valve fault condition and fluid is in the disposable set, keep the patient line clamped closed when opening the door to prevent uncontrolled fluid flow.
WATCH DOG (no message)	Internal computer malfunction	Stop pumping and heating. Sounds a high pitch tone.	Restart the system, service machine if error persists. **CAUTION:** In a Watch Dog alarm condition and fluid in the disposable set, keep the patient line clamped closed when opening the door to prevent uncontrolled fluid flow.

TROUBLESHOOTING OTHER OPERATIONAL DIFFICULTIES

There are times that problems occur that are outside the comprehensive surveillance system. These can be due to improper setup, faulty accessory equipment, or internal failure of a component. This table describes several of these potential problems, the alarm that might be generated (if any), and the corrective actions to take.

PROBLEM	POSSIBLE CONDITION	PROBABLE ALARM OR MESSAGE	OPERATOR ACTION
Alarm volume too low	Alarm volume in Setup Routine has been turned down to the lowest volume setting.	NA	Increase volume setting in System Setup, Chapter IV.
Battery No Heating	Power cord not plugged in AC power	NA	Plug into AC receptacle; check power cord connection. Keep the system plugged in to charge the battery.
Dim display	Display brightness in Setup Routine has been turned down to the lowest brightness setting.	NA	Increase display brightness in System Setup, Chapter IV.
Flow rate is slowing down or will not go at the set rate	The system is keeping the pressure in the line under the Pressure Limit by reducing the infusion rate.	Pressure reading flashes at "Pressure Status Line" and system periodically beeps.	Check and remove kinks or obstructions in the tubing. Use the appropriate infusion set recommended in the guide, Match the Infusion Set to Flow Rate and Fluid Type in Chapter II. Increase flow by increasing the Pressure Limit. Change the Pressure Limit in Calibration/Setup to a higher limit (maximum Pressure Limit is 300 mm Hg).

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PROBLEM	POSSIBLE CONDITION	PROBABLE ALARM OR MESSAGE	OPERATOR ACTION
Key pad does not accept input	The key pad is being continually depressed. Key pad failure	Constant beep	Release the key pad and the constant beep will cease. If the alarm persists, power down and service machine.
Key pad is too sensitive or not responsive	Key pad sensitivity in Setup Routine has been set at Fast or Slow.	NA	Reset key pad sensitivity in System Setup, Chapter IV.
No message, beep tone	Power switch not completely depressed or membrane switch failed.	Constant beep	Depress power switch completely. If problem persists, replace the membrane switch.
No power or battery run time is too short	Power cord not plugged into AC power. Batteries discharged in DC operation.	NA	Change AC power source; check power cord connections. Recharge internal battery by connecting the power cord to the AC line. If the battery run time is less than ½ hour after a full 8 hour charge, call service to replace the rechargeable battery.
Power off immediately after switch to ON. System turns on for 2-3 seconds, then turn off automatically	IGBT's on Driver 'A' and 'B' shorted. EPROM is not seated in the socket properly.	System turns on then off immediately. System turns on for 2-3 seconds, then turns off automatically.	If the problem persists, power down and service machine. Reinsert the EPROM on the Computer Board.
Pump is running too loud	Roller pump is hitting the door or pump tubing is not properly installed.	NA	1. Open the door and reinsert the pump tubing. 2. Check to make sure that there is no blood or debris around the door hinges caused the door to lift up resulting in the roller pump hitting the door hub.

PROBLEM	POSSIBLE CONDITION	PROBABLE ALARM OR MESSAGE	OPERATOR ACTION
System does not heat to physiologic temperature	Windows on the disposable or IR sensor is wet or dirty. Power module is not calibrated properly. Power module malfunction or temperature probes are out of calibration.	Incorrect temperature display. Heating fault message.	Examine the windows on the disposable set for wetness or contaminants. Clean window with soft cloth and alcohol if necessary. See procedure on power calibration in Chapter IV. Check temperature probe calibration in Chapter IV. Service machine if problem persists.
System does not prime	See Fluid Out in Alarm Message of this chapter	System will not count down from 100 to 0 ml in Prime.	Check the reservoir or recirculate line and make certain that it is not obstructed, the fluid bags are fully spiked and clamps are open. The pump tubing should not be stretched too taut and it must be firmly seated within the sensor. See Fluid Out in Alarm Message of this chapter
Unable to calibrate temperature probes	Temp probe malfunction Incorrect fluid temperature used for calibration.	NA	Check the temperature of fluid and make certain it is correct. If problems persists, service machine.
Unable to turn the system off	One of the components on Daughter Board failed.	System does not turn off, runs on battery until shut down.	Service machine.